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ABSTRACT

Noting that metacognition plays a vital role in reading, this report summarizes research dealing with the development of metacognition in an especially important type of reading--reading to learn. The report is organized around four categories of metacognitive knowledge and control: (1) the text, (2) the task to be performed by the learner as evidence of learning, (3) the learner's strategies, and (4) the learner's characteristics. Among the conclusions presented are that the development of knowledge appears to precede the development of control, younger and poorer readers tend to be deficient in both knowledge and control of the four variables, and instruction in metacognitive skills can have a positive effect on learning outcomes. (FL)

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Reading Education Report No. 40

THE ROLE OF METACOGNITION IN READING TO LEARN: A DEVELOPMENTAL PERSPECTIVE

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Abstract

This report summarizes selected research on the development of metacognition in a particularly important type of reading--reading in order to learn. Metacognition in reading to learn involves the knowledge and control of four variables and the manner in which they interact to produce learning: the text, the task to be performed by the learner as evidence of learning, the learner's strategies, and the learner's characteristics. This review is organized around these four categories of metacognitive knowledge and control. Some conclusions from the research are that (a) younger and poorer readers tend to be deficient in both knowledge and control of the four variables, (b) the development of knowledge appears to precede the development of control, and (c) instruction in metacognitive skills can have a positive effect on learning outcomes.

The Role of Metacognition in Reading to Learn: A Developmental Perspective

As research increasingly reveals, metacognition plays a vital role in reading. Any treatment of reading, therefore, must include a discussion of metacognitive knowledge and skills and their implications for effective reading. This is a summary of selected research on the development of metacognition in a particularly important type of reading--reading in order to learn.

In a literal sense, the term metacognition means "transcending knowledge." As used by cognitive psychologists, metacognition refers to both the knowledge and the control an individual has over his or her own thinking and learning (Baker & Brown, in press; Brown, 1978, 1980; Flavell, 1978). Metacognition in reading to learn involves the knowledge of four variables and the manner in which they interact to produce learning (Brown, Campione, & Day, 1981; Flavell & Wellman, 1977). These variables are: (a) text--the features of the to-be-learned materials that influence comprehension and memory (e.g., difficulty, familiarity, interest, structure); (b) task--the storage and retrieval requirements of the task to be performed by the learner as evidence of learning; (c) strategies--the activities engaged in by the learner to store and retrieve information from the text; and (d) learner characteristics--ability, motivation, and other personal attributes and states that influence learning.

Metacognition in reading to learn also involves control or self-regulation. The effective learner must coordinate the complex interaction

of the four variables. This review is organized around these four categories of metacognitive knowledge and control. Of course, since the four variables interact in a complex way in any learning situation, this classification scheme is necessarily somewhat arbitrary.

Text

Many features of text influence students' learning, including topic or content (readers' familiarity, interest), vocabulary, syntax, and "clarity" of presentation (its style, structure, coherence). One focus of research in metacognitive development has been on structure--the rhetorical and logical organization of the text. Salient findings of the research are that (a) structure influences learning even if the learner is unaware of the effect; (b) knowledge of the effect of structure on learning is related to both age and ability; and (c) the learner can maximize learning if he or she is aware of the structure and the effect of structure on learning.

The first two findings are illustrated in a study by Brown and Smiley (1977). In this study, 8-, 10-, 12-, and 18-year-olds were asked to evaluate the importance of the idea units of complex folk tales by rating them according to four levels of relative importance to the theme of the passage (an idea unit expresses one "idea" in the text, usually consisting of a subject and its verb or verb phrase). After students rated one story, they read and recalled another story. Results showed that the ability to distinguish relative importance was strongly related to age. Eighteen-year-olds could reliably discriminate across the four levels of importance, while 8-year-olds made no reliable distinction between levels of importance in their ratings. Even junior high school students had some

difficulty deciding on the relative importance of text elements. Recall patterns, however, were similar across age levels. Students at all ages tended to recall the most important information most frequently and the least important information least frequently. Thus, recall is differentially affected by importance level in the text even without awareness of relative importance.

Danner (1976) found a similar pattern of results with younger children. Danner presented children in grades 2, 4, and 6 with short expository passages. The sentences comprising the passages were either organized around three topics or arranged randomly. The children were asked to perform several tasks, including recalling the passages and determining which passage type was more difficult to learn. They had to justify their answers. For all subjects, organized passages were recalled better than disorganized ones. Although the majority of children reported that disorganized passages were more difficult to remember, only older children attributed the difficulty to differences in structure. In the Danner study, as in the Brown and Smiley study, therefore, passage structure affected recall and perceived difficulty of recall for even the youngest children; however, only the oldest children were aware of the structure and its effect on learning.

Although text features may affect learning in the absence of metacognition, awareness of the role of text features in learning is essential if the learner is to use the features consciously to enhance learning from text. Several studies demonstrate this point. Owings, Petersen, Bransford, Morris, and Stein (1980) manipulated the logical

structure of passages by varying the extent to which descriptions of characters were logically related to their behaviors. In "nonarbitrary" versions of the stories, subjects and predicates were appropriate and consistent with each other. For example, The hungry boy had eaten the hamburger; The sick boy had gone to the doctor. In the "arbitrary" versions, the subjects and predicates of these sentences were re-paired, generating such strings as: The sleepy boy had eaten the hamburger; The hungry boy had played basketball.

Successful and less successful fifth graders read and studied "arbitrary" and "nonarbitrary" versions of stories, rated them for difficulty and justified their response, then recalled the stories. All children remembered the logically structured passage better than the arbitrary passage, but only the more successful students consistently recognized that the arbitrary passage was more difficult and justified their answers appropriately. Furthermore, the better students spent more time reading and studying the arbitrary passages, while the less successful students spent equal amounts of time for the two passage types. Aware of the difference in text structure and the effect of this difference on learning, the better students were able to adjust their studying strategies accordingly. The poorer students, on the other hand, were not aware of the structural differences and thus made no appropriate adjustment in their studying behaviors.

Brown and Smiley (1978), in a study that followed from their previously cited 1977 study, also demonstrated that knowledge of text structure is critical for efficient use of study time. In Brown and Smiley

(1977), children under 10 were not adept at identifying different levels of importance of ideas in text. In the 1978 study, students from fifth grade through college level were asked to read and study passages prior to a recall task. Given extra study time, children from seventh grade and above improved their recall of important text elements but not of less important details. If children below seventh grade showed any improvement at all, they tended to increase recall of both important and less important information. The students also showed differences in studying behavior. Younger children tended simply to reread the text during the study time, while older students showed a greater tendency to underline or take notes. However, some students at all ages did underline or take notes. This subgroup of spontaneous underliners/notetakers focused their studying on the important information; they also tended to improve their recall of important elements. Drawing on the results of their previous study, Brown and Smiley (1978) concluded that younger and less mature students did not concentrate on important elements because they did not know what was important, while older students could study effectively because they not only knew what was important but also what strategies they could use to improve their skills. As with the Owings et al. (1980) study, the results indicate that knowledge of the effect of text structure on learning is prerequisite to conscious control of strategies that accommodate this feature.

An encouraging line of research indicates that less mature students can be taught to identify and use text structure to facilitate learning. For example, Bartlett (1978) taught ninth graders over the span of five

class periods to identify and use four common expository text structures as an aid to learning. The recall of the trained group both one day and three weeks after instruction was significantly greater than either their preinstruction performance or the performance of an untrained control group. Likewise, Dansereau (in press) noted that college students have been successfully trained to identify and use the inherent structure of text as an aid to learning. One successful technique involved advance organization, while another gave instruction in the purpose and utility of embedded headings in a text.

Another area of research in the development of metacognition of text features is particularly related to the control aspect of metacognition. This research is concerned with awareness of inadequacies (anomalies, ambiguities, confusions, etc.) in prose. Like the research on text structure, this line of research demonstrates that inadequacies in a text affect cognitive processing even if the reader is unaware of them, and that knowledge of inadequacies in text is a late-developing ability. Two studies illustrate these points.

Harris, Kruithof, Meerum Terwogt, and Visser (1981) had 8- and 11-year-old children read stories containing two target lines, one appropriate and the other anomalous relative to the prior context of a title. Reading time was recorded for each line of the stories, and after each story subjects were asked to indicate a line that did "not fit in with the rest of the story." Both age groups read the anomalous line more slowly than the appropriate line, but the older group was more likely than the younger group to select the anomalous line. Like text structure, anomalies

affected cognitive processing before children developed the ability to monitor the effect.

A similar study with college students indicates that evaluating text for consistency and coherence is not a routine behavior even among adults. In this study by Baker and Anderson (in press), college students read text containing "confusions" (i.e., contradictions) as it was presented sentence by sentence on a computer screen. Students could read through the text at their own pace and could return to previous sentences. The computer recorded the total amount of time spent on each sentence and the pattern of movement through the text. After reading the passages, students were asked to point out any sentences that contained confusions. Students spent more time reading confusing than nonconfusing text, and they looked back at previous sentences more often when confusions were present; however, less than 25% of the students noticed all intended confusions, and only 67% of the confusions were reported by the students. Thus, for college students as well as children, "automatic" cognitive processing can proceed smoothly even in the absence of metacognition.

Task

In reading to learn, the student has one or more tasks, purposes, or goals to accomplish. These tasks vary in the kinds of cognitive demands required to perform them. For example, the processes involved in locating a specific detail in a text are quite different from those required to write a critique or perform a complex procedure from memory. Effective performance on any task depends on the learner's awareness of the

processing and retrieval demands of the tasks as well as his or her ability to adapt reading and studying to meet these demands. As with other facets of metacognition, mature and immature learners differ with respect to their knowledge of, and ability to control, task variables.

The most fundamental task, purpose, or goal in learning from reading is comprehension, the derivation of meaning from the text. Mature and immature learners differ in their conceptions of even this most basic task. In general, younger and poorer learners are not aware that they must attempt to make sense of the text; to them, reading is a decoding process rather than a search for meaning and a means of learning (Canney & Winograd, 1979; Denny & Weintraub, 1963, 1966; Johns & Ellis, 1976; Myers & Paris, 1978). For example, Canney and Winograd (1979) investigated second, fourth, sixth and eighth graders' conceptions of reading using both interviews and tests. In the interview part of the study, students were asked, "What is reading?" At all grade levels, better comprehenders (determined by teacher judgments in combination with standardized test scores) were more aware of meaning-focused features of reading than poorer comprehenders. The poorer comprehenders attended more to the mechanical, decoding aspect of reading. Furthermore, the difference between the emphases of better and poorer comprehenders increased with age. Clearly, students must be aware that the purpose of reading is to derive meaning from text if any learning is to occur.

Even if students know that the purpose of reading is to derive meaning, the battle is hardly won. The learners must also know how to modify their reading behaviors appropriately in response to various tasks.

For example, they must know to slow down when the content is difficult or that they can speed up when an overview is all that is required. Research indicates that the ability to adjust reading strategy according to task changes with age and general reading ability.

Smith (1967) asked twelfth-grade readers (good and poor) to read for two different purposes: details and general impressions. After reading, students were interviewed about the processes they used when they read for the two different purposes. Good readers reported that they adjusted the procedures they used according to the purpose. They claimed to use a variety of procedures and, in general, the specific procedures used for the two purposes were different. On the other hand, poor readers made only slight variations in their approach when reading for the two purposes. In addition, good readers were more successful than poor readers in keeping the purpose for reading in mind.

In a study by Forrest and Waller (Note 1), third and sixth graders read two 500-word stories under each of four different instructions: (a) read for fun; (b) read to make up a title; (c) read as quickly as possible to find one specific piece of information (skim); and (d) read to study. After each story, the children took a multiple-choice comprehension test. The ability to adjust reading strategy in response to assigned purpose increased with age and reading ability, as reflected in performance on the comprehension test within the four conditions. Only with sixth-grade good readers was retention significantly higher in both the "study" and "title" conditions than in the "skim" condition.

Kobasigawa, Ransom, and Holland (1980) studied the task in learning situations of locating specific information in text. They investigated children's knowledge about skimming as a strategy to meet such a task demand. Fourth, sixth, and eighth graders were directed to find specific types of information in short passages. In one passage, the information could be located most efficiently by skimming the first sentence of the paragraph; in another passage, the information could be found by skimming the entire passage for a key word. Students were also interviewed to determine their awareness of skimming techniques. Children at all three grade levels had knowledge of relevant text characteristics (i.e., the function of first sentences of paragraphs and how relevant information may be expressed in prose); children at all levels were also able to skim when explicitly instructed how to do so. However, spontaneous skimming as a strategy to meet task requirements developed only gradually with age. Thus, students may have relevant knowledge, including the implications of specific task demands, but still not be aware that they can make use of this knowledge to facilitate learning.

Another aspect of metacognition of task characteristics is the learner's estimation of his or her degree of learning with respect to the demands of the task. Sensitivity to the match between knowledge and demands is a particularly late-developing metacognitive skill. One clue to the development of this type of metacognition is in students' selection of **retrieval cues** as they prepare for future recall attempts. A retrieval cue helps the learner remember what he or she needs to know in order to perform a task; retrieval cue selection thus reflects the learner's estimation of

memory capacity with respect to task demands. An example of research on retrieval cue selection is the previously cited study by Danner (1976). The children in this study were asked to select retrieval cues--three sentences that would later help them remember the rest of the passage--and to explain their selections. The number of children who explained that they selected review notes according to the topical organization of the passage increased significantly with grade level. It was not until sixth grade that the majority of children could select a suitable sentence, that is, the topic sentence, as a cue to retrieving a paragraph from memory.

An even more telling example of research on retrieval cue selection was reported by Brown, Smiley, and Lawton (1978) and Brown and Campione (1979). Students from fifth through twelfth grade and college students were asked to study passages until they could recall all the details in their own words. They were allowed repeated study trials. The passages were divided into constituent idea units rated in terms of their importance to the theme; there were four levels of rated importance. On each trial the students were allowed to select a subset of the idea units (printed on cards) to keep with them while they attempted recall. After recall and a rest period, the entire process was repeated.

On the first trial, the majority of students at all ages selected the most important units to help them recall. Children below high school age continued to do this, even though across trials they became perfectly able to recall the most important information without aid, and persistently failed to recall additional details. College students, however, modified their selection as a function of trials: on the first trial they selected

predominantly important (fourth-level) units for retrieval aids. On the second trial they shifted to a preference for the third-level units, while on the third trial they preferred second-level units. On all three trials, the lowest-level units were treated appropriately as trivia. As they learned more and more of the material, college students shifted their choice of retrieval cues to reflect their estimated state of knowledge with respect to the task.

Older high school students showed the same basic pattern as the college students, but they were one trial behind; they did not begin to shift to less important units until the third trial. This lag could be due to slower learning. That is, both groups shifted when they reached the same criterion of learning, but the younger students took an extra trial to reach this criterion. The lag could also be due to a slower selection of the effective study strategy of switching to less important units. That is, both groups learned as much on each trial, but it took high school students longer to realize that they needed to shift cue selection. The second explanation seems more likely because, even when students were matched on the basis of degree of learning, the younger students still took longer to shift their choice of retrieval cues.

Brown, Smiley, and Lawton (1978) and Brown and Campione (1979) concluded that the ability to select suitable retrieval cues is a late-developing skill because it requires such a fine degree of sensitivity to the demands of studying. The successful user of the flexible retrieval plan illustrated in these studies must have (a) information concerning his or her current state of knowledge, i.e., what he or she knows and does not

yet know of the text; (b) knowledge of the fine gradation of importance of various elements of texts (what is important to know and what can be disregarded); and (c) the strategic knowledge to select retrieval cues from the previously missed information.

A final, related index of metacognitive development with regard to the task is the learner's ability to predict performance on the task. In the previously cited study by Forrest and Waller (Note 1), third and sixth graders were asked to rate their confidence in their performance on the multiple-choice test that followed each reading selection. Analyses of confidence ratings showed that success at assessing comprehension and predicting performance increased with both grade and reading ability. The students were also asked the question "Could you tell how well you had done on a test before you got it back from the teacher?" Third graders claimed there was no way to predict accuracy, while sixth graders indicated some cues that could give them information on test performance, such as the difficulty level of the questions, the length of time spent answering questions, and the number of responses of which they felt confident.

Strategies

Metacognition involves not only knowing what one does and does not know but also knowing what to do to remedy comprehension failures in order to increase learning. This knowledge is metacognition about strategies. Researchers have focused on two different kinds of strategies: "fix-up" strategies to resolve comprehension failures, and studying strategies to enhance storage and retrieval (where comprehension failures is not necessarily an issue).

"Fix-up" strategies. When comprehension fails, the reader must make several important strategic decisions. First, the reader must decide whether to take any remedial action, a decision that depends largely on the purpose for reading (Alessi, Anderson, & Goetz, 1979). If the reader decides to take some action, these are the options: store the confusion in memory as a pending question in the hope that clarification will be forthcoming; reread the text; look ahead in the text; or consult another source. These strategies have been called "fix-up" strategies (Alessi et al., 1979). Evidence on the development of "fix-up" strategies comes from several sources.

Among the interview questions asked by Myers and Paris (1978) of second and sixth graders in the study described earlier were questions tapping awareness of "fix-up" strategies for comprehension failures at the word and sentence level. Older children tended to say they would resolve a difficulty by using a dictionary or asking another person. Younger children had few strategies for deciphering the meaning of unknown words or sentences and were more insensitive to the need for resolving comprehension failures.

In another study, Paris and Myers (1981) obtained several measures of the comprehension monitoring and study strategies of good and poor readers in the fourth grade. In one phase of the study, students were directed to read and remember a story containing some difficult vocabulary words. They were each provided with blank paper, a pencil, and a dictionary and told they could write or ask questions. Good readers asked questions, took notes, and used the dictionary more than poor readers. Furthermore, only

good readers asked for the meanings of unknown words; poor readers were more interested in the pronunciation.

The "fix-up" strategy that has received the most attention is "lookbacks" (Alessi et al., 1979); that is, looking back at or rereading relevant sections of previously read text to resolve comprehension failures. Alessi et al. (1979) used questions interspersed in a text presented on a computer in order to help students detect comprehension problems. When students in one experimental condition answered a question incorrectly, the computer forced them to "look back" to the relevant text section. This induced lookback procedure helped students resolve comprehension failures.

The Alessi et al. (1979) finding prompted Garner and her colleagues (Garner & Reis, 1981; Gardner, Note 2; Garner, Wagoner, & Smith, Note 3) to pursue research on the use of lookbacks by younger students. In a study by Garner and Reis (1981), middle school students read narratives containing "lookback questions" (questions demanding recall of previously presented information). The students were observed for signs of comprehension monitoring (recognition of difficulty while answering questions) and attempts to remedy failure on questions by looking back in the text. Poorer comprehenders at the sixth-, seventh-, and eighth-grade levels failed to either monitor or correct comprehension failures. Better comprehenders in grades 6 and 7 monitored comprehension but did not spontaneously use lookbacks. Eighth-grade better comprehenders, on the other hand, both monitored comprehension and "fixed-up" comprehension problems by looking back to relevant sections of text. Garner (Note 2) replicated the Garner

and Reis finding of differences in lookback behavior as a function of reading proficiency. In addition, Garner found that both good and poor comprehenders in grades 6 and 7 improved their reading and question answering after training and practice in the lookback strategy.

Garner, Wagoner, and Smith (Note 3) observed the behavior of good and poor comprehenders in grade 6 as they tutored fourth graders and used this behavior as an index of the sixth graders' metacognitive development. The task involved reading an expository passage and answering reader- and text-based questions about the passage. (Reader-based questions could be answered from the reader's existing knowledge; text-based questions could be answered from information presented in the passage.) Results showed significant differences between good and poor comprehenders on several measures: (a) the number of times they encouraged the younger children to "look back" in the text; (b) the number of times they encouraged lookbacks for text-based questions (where lookbacks are appropriate) versus reader-based questions (where the lookbacks are inappropriate); and (c) their ability to direct attention to the relevant text segment for answering the question. In other words, good comprehenders encouraged their tutees to use lookbacks and informed them when and where to do so; poor comprehenders were less effective tutors. The fact that good readers attempt to teach this lookback strategy to younger children seems good evidence that they are well aware of the usefulness of this strategy for learning.

Studying strategies. Another important class of strategies in reading to learn is studying strategies--student activities to enhance text processing and memory. Some of the more common studying strategies are

underlining, notetaking, outlining, summarizing, and self-questioning. Little research bears directly on the development of metacognition related to these complex and sophisticated strategies, but they do appear to be rather late developing. Indeed, even many college students are not well informed about the potential repertoire of strategic studying skills (Anderson, 1980; Brown, Campione, & Day, 1981; Dansereau, Long, McDonald, & Atkinson, 1975).

In considering studying strategies, it is important to distinguish between a technique and a strategy. Students can use a technique "blindly," that is, without using it strategically in processing text information. A technique becomes a strategy only if students have the (metacognitive) knowledge of when, where, and how to use it. This distinction between techniques and strategies may help explain the lack of effect found in the research on studying (see Anderson & Armbruster, 1980), in which students are often induced to use techniques whether or not they have the metacognitive skills to use them strategically.

The difference between using a technique and a strategy is illustrated in the Brown and Smiley (1977) study. In this study, even some fifth graders spontaneously underlined or took notes on the important information in the text. They used extra study time to improve their recall of important text elements and subsequently exhibited a more adultlike pattern of recall. Students who did not use a studying technique spontaneously but only when induced to do so were not able to use the technique to advantage. They underlined or took notes more randomly than the spontaneous users, and did not recall as well. The students who underlined or took notes

spontaneously had apparently developed the metacognitve skills to enable them to use the techniques as effective studying strategies. Students who were induced to underline or take notes were probably using the techniques blindly, without the metacognitive knowledge of when, where, and how to use them to advantage.

Most of the evidence on the development of metacognition related to studying strategies comes from training studies in which students were taught to use a particular strategy that substantially improved their performance on the criterion task. Presumably, such improvement was possible because the students had been deficient in the tools for effective learning from text, including metacognitive skills. The successful training studies all included instruction to heighten students' metacognitive awareness of the studying situation, including when, where, and how a strategy should be used. Among the successful training studies in studying strategies are the following: teaching outlining to high school students (Barton, 1930); training seventh, ninth, and twelfth graders to outline and summarize (Salisbury, 1935); instructing average and remedial junior college students to summarize (Day, 1980); teaching self-questioning skills to high school students (André & Anderson, 1978-79) and seventh-grade poor comprehenders (Brown & Palincsar, 1982); and training hearing (Dansereau, 1979) and hearing-impaired (Long, Hein, & Coggiola, 1978) college students to use a semantic mapping method.

Learner Characteristics

A final major facet of metacognition is the learner's awareness of his or her own characteristics (such as background knowledge, interest, skills, and deficiencies), how these characteristics affect learning, and how reading and studying behaviors should be adjusted accordingly. Little research has been concerned with metacognition of learner characteristics related to learning from text. In the Myers and Paris (1978) interview study, both second and sixth graders were aware that background knowledge and interest affect reading. However, there is a difference between knowing that these characteristics affect reading and knowing how to control these variables in learning from text.

One learner characteristic that has received attention in research on metacognition is the awareness and activation of relevant prior knowledge. Bransford, Stein, Shelton, and Owings (1980) report a study with fifth graders in which they observed that in contrast to successful students, less successful students showed little tendency to relate information in text to previous knowledge, including information presented previously in the text. Another study by Bransford and his colleagues (cited in Brown, Bransford, Ferrara, & Campione, in press) replicated the finding that less successful fifth graders were less likely to use their knowledge to clarify the significance of factual content and make it more memorable, even though the necessary knowledge was available in the text itself. Fortunately, Bransford et al. (1980) report success in teaching students to ask themselves questions designed to activate relevant prior knowledge. Sullivan (1978) reported that poor readers at the high school level also

have difficulty relating prior knowledge to what they are reading. Even at the college level, individual differences in the use of background knowledge during reading have been documented (Spiro & Tirre, 1979). Thus, as with texts, tasks, and strategies, the metacognitive skill distinguishes mature and immature learners. In the case of learner characteristics, a distinguishing skill is the extent of utilization of background knowledge during reading.

Conclusion

The research reveals a consistent pattern regarding metacognitive development in reading to learn. The development of metacognition is related to proficiency in learning. In general, younger and poorer readers have a less adequate understanding of how the various factors involved in the learning situation (the characteristics of the text, the requirements of the task, applicable strategies and their own abilities and deficiencies) will affect their ability to learn from reading. Furthermore, younger and poorer readers tend to be less adept at using what knowledge they do have about characteristics of the learning situation to enhance their learning. In other words, younger and poorer readers tend to be deficient in both components of metacognition: knowledge and control.

It is not, however, only with younger and poorer readers that deficiencies in metacognitive skills are found. Another, perhaps surprising, finding is that older individuals, including high school and even college students, often show inadequacies in certain areas of

metacognitive knowledge or the use of this knowledge. Studying skills are among the particularly late-developing metacognitive skills.

Another, albeit tentative, conclusion about metacognitive development is that knowledge precedes control. As was particularly clear from the research on metacognition related to text, learners are influenced by the characteristics of text long before they are aware of (or at least able to describe) these factors and their importance to learning. It seems that learners must have **knowledge** of the effects of the factors of text, as well as knowledge of the task and their own characteristics as learners, before they can strategically **control** the learning process to optimize the influence of these factors. The notion that knowledge precedes control may help explain why studying skills are so late in developing: Before the learner can use effective studying strategies, he or she must be aware of text, task, and self, and how they interact to affect learning.

Of particular interest to educators is the finding that instruction in at least some metacognitive skills can have a positive effect on learning outcomes. For example, training in the "lookback" strategy improved reading comprehension for both younger and poorer readers (Garner, Note 2), and teaching the recognition and use of text structures facilitated ninth graders' recall of text (Bartlett, 1978).

Research on the development of metacognition has not only shown that instruction can be effective, but it has also suggested **how** teachers can best help students learn from reading. The major practical implication of the research is that students should be taught to consider the four factors involved in learning (text, task, strategies, and learner characteristics)

and how they interact to influence learning outcomes (Brown, Campione, & Day, 1981). Specifically, students could be taught to identify **text features**, such as structure and logical consistency, that are known to influence learning. **Task-related skills** to be taught could include identifying or establishing the purpose for reading and adjusting studying effort accordingly. Students could be instructed in specific studying **strategies** (such as notetaking and semantic mapping) as well as in general comprehension and self-monitoring activities (such as reading for a purpose and noting and "fixing-up" confusions). Instruction related to **learner characteristics** could help students develop awareness of their own capabilities, including the limitations of their memories, prior knowledge of the to-be-learned content, competence in performing specific tasks, and mastery of learning strategies. Finally, students could be helped to develop **control** of learning by being informed about the interaction of the factors and the importance of assuming an active role in regulating the interaction. For example, students could be taught to modify studying strategies for unfamiliar content, or for a particular kind of text, or for text having a particular structure. It is certain that students can be made aware of the influence on learning of the characteristics of text, task, strategies, and their own selves as learners. Metacognitive knowledge of this sort can enable students to become more effective learners.

Reference Notes

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